Fundamental unit of area: black hole horizon statistical mechanics

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- The entropy is the statistical entropy associated with rearrangements of identical gravitons.

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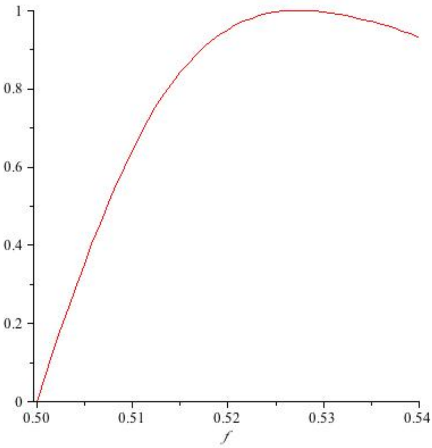
- Bekenstein-Hawking entropy $S = kA/4\hbar$, $A = 8\pi[M^2 + \surd(M^4 - J^2)]$, so that $M^2 = A/16\pi + 4\pi J^2/A$.

Result: Spin a/M of the hole

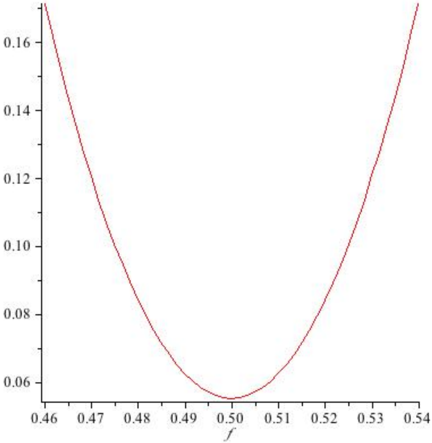
$$a/M = 2(2f-1)\left[\frac{\alpha(f)}{4\pi} + \frac{4\pi(2f-1)^2}{\alpha(f)}\right]^{-1} .$$



Result: Mass of the hole

$$M^2 = \hbar N \left[\frac{\alpha(f)}{4\pi} + \frac{4\pi(2f-1)^2}{\alpha(f)} \right].$$

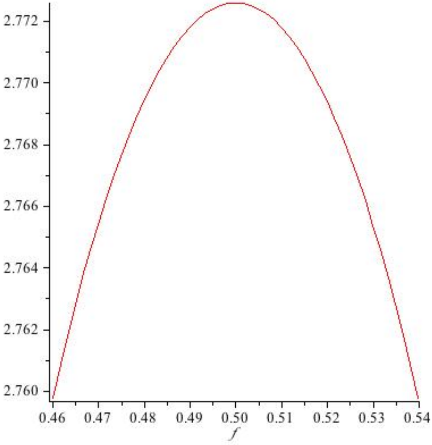
$M^2/\hbar N$:



Result: Fundamental Quantum of Area

$$\delta A = A/N = 4\hbar\alpha(f)$$

Only tiny variation between Schwarzschild and Kerr: $\delta A/\hbar$

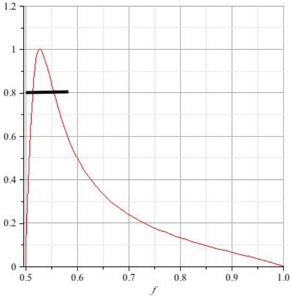


Energy per graviton

$$E_g = M/N = \frac{\hbar}{M}\left[\frac{\alpha(f)}{4\pi} + \frac{4\pi(2f-1)^2}{\alpha(f)}\right].$$

Sensible: typical wavelength of order M.

Two ways of making a Kerr Hole?



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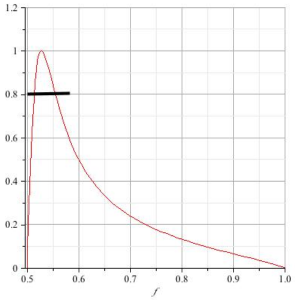

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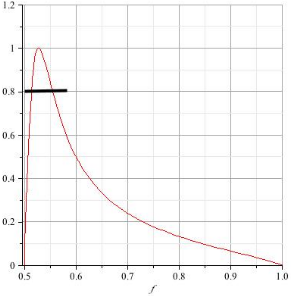

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- Why does temperature vanish at $a/M = 1$?

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- ,4-¿ Very challenging counter-example by Gerhard, not fully understood.
- Conclusion: may not be able to understand this without an experiment!

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